WHAT IS CLAIMED IS:

1. A combustion engine for combusting hydrocarbon fuel, the combustion engine comprising:

an engine housing having a combustion chamber;

an air intake port fluidly connected to the engine housing and being configured to provide air thereto;

a mixed conductor having a retentate side and a permeate side, the retentate side being fluidly connected to the air intake port, the permeate side being exposed to the combustion chamber, the mixed conductor being configured to conduct oxygen ions from the retentate side to the permeate side when a partial pressure of oxygen in the air on the permeate side is less than a partial pressure of oxygen on the retentate side for providing an oxygen-pure fraction of the air to the combustion chamber;

a water intake port fluidly connected to the combustion chamber and being configured to provide pressurized water to the combustion chamber for subsequent combustion with the hydrocarbon fuel and the oxygen-pure fraction of the air to produce exhaust fluid;

an exhaust turbine having an exhaust turbine inlet, an exhaust turbine outlet and a turbine rotor rotatably coupled to the engine housing, the exhaust turbine inlet being fluidly connected to the combustion chamber for receiving the exhaust fluid, the turbine rotor being configured to rotate upon expansion of the received exhaust fluid from the exhaust fluid inlet, the exhaust turbine outlet being configured to receive the expanded exhaust fluid from the turbine rotor; and

a hydrogen compressor assembly fluidly connected to the exhaust turbine outlet for receiving the exhaust fluid, the hydrogen compressor assembly being configured to

extract hydrogen from the exhaust fluid and pressurize the extracted exhaust fluid, the hydrogen compressor assembly being further configured to deliver the extracted pressurized hydrogen to the exhaust turbine inlet for recirculation through the exhaust turbine.

2. The combustion engine of Claim 1 further comprising a heating system in thermal contact with the mixed conductor, the heating system being configured to heat the mixed conductor.

3. The combustion engine of Claim 2 wherein the exhaust fluid contains a residual oxygen-enriched fraction of air, the heating system including an electrical heating element configured to ignite the residual oxygen-enriched fraction of air.

4. The combustion engine of Claim 1 wherein the exhaust fluid is partially comprised of carbon monoxide, the combustion engine further comprising an iron oxide catalyst for converting a portion of the carbon monoxide into carbon dioxide, the iron oxide catalyst being disposed within the combustion chamber.

5. The combustion engine of Claim 1 wherein the exhaust fluid is at least partially comprised of hydrogen, steam, water and carbon dioxide, the hydrogen compressor assembly including:

a first metal hydride hydrogen compressor fluidly connected to the exhaust turbine outlet for receiving the exhaust fluid, the first metal hydride hydrogen compressor being configured to condense the steam and to adsorb and pressurize a portion of the hydrogen contained in the exhaust fluid;

a gas absorber fluidly connected to the first metal hydride hydrogen compressor for receiving the exhaust fluid and the hydrogen, the gas absorber being configured to allow the water in the exhaust fluid to absorb the carbon dioxide; and

a second metal hydride hydrogen compressor fluidly connected to the gas absorber for receiving the exhaust fluid and the hydrogen, the second metal hydride hydrogen compressor being configured to adsorb and pressurize a portion of the hydrogen and to vent a portion of the carbon dioxide to atmosphere.

6. The combustion engine of Claim 5 further comprising a desiccant fluidly connected between the gas absorber and the second metal hydride hydrogen compressor, the desiccant being configured to remove moisture from the hydrogen.

7. The combustion engine of Claim 5 further comprising a first water pump fluidly connected to the first metal hydride hydrogen compressor for receiving the condensed steam, the first water pump being configured to pressurize the condensed steam.

8. The combustion engine of Claim 5 further comprising:

a gas desorber fluidly connected to the second metal hydride hydrogen compressor for receiving the exhaust fluid, the gas desorber being configured to extract carbon dioxide from the water and vent a remaining portion of the carbon dioxide to atmosphere; and

a second heat exchanger fluidly connected between the gas absorber and the gas desorber for receiving the water, the second heat exchanger being configured to air cool the water;

wherein the gas absorber is fluidly connected to the second heat exchanger for receiving the cooled water, the gas absorber being configured to be cooled by the cooled water for allowing the water in the exhaust fluid to absorb carbon dioxide.

9. The combustion engine of Claim 5 wherein the hydrogen compressor assembly further includes:

a first accumulator fluidly connected to the gas absorber for receiving the hydrogen, the first accumulator being configured to store the hydrogen;

a first control valve fluidly connected between the first accumulator and the second metal hydride hydrogen compressor; and

a nickel metal hydride battery fluidly connected to the first control valve, the first control valve being operative to regulate the flow of hydrogen from the first accumulator to the nickel metal hydride battery.

10. The combustion engine of Claim 9 wherein the hydrogen compressor assembly further includes:

a second accumulator fluidly connected to the first metal hydride hydrogen compressor for receiving the portion of the hydrogen, the second accumulator being configured to store the portion of the hydrogen; and

a second control valve fluidly connected to the second accumulator, the second control valve being operative to regulate the flow of the portion of the hydrogen from the second accumulator to the combustion chamber.

11. The combustion engine of Claim 7 further comprising an intake compressor fluidly connected to the air intake port, the intake compressor being configured to pressurize the air.

12. The combustion engine of Claim 11 further comprising a first recuperator fluidly connected to the intake compressor for receiving the pressurized air, the first recuperator being configured to heat the pressurized air.

13. The combustion engine of Claim 12 further comprising a second recuperator fluidly connected to the first water pump, the first metal hydride hydrogen compressor, the exhaust turbine and the combustion chamber, the second recuperator being configured to cross-circulate exhaust fluid from the exhaust turbine outlet, condensed steam from the first water pump, and the portion of the hydrogen from the first metal hydride hydrogen compressor for exchanging heat between the exhaust fluid, the condensed steam and the portion of the hydrogen.

14. The combustion engine of Claim 13 wherein the exhaust fluid received from the first metal hydride hydrogen compressor contains carbon monoxide and the second recuperator is coated with cuprous oxide for promoting a low temperature water-gas shift reaction for converting the carbon monoxide into carbon dioxide.

15. A method of rotating a turbine rotor of an exhaust turbine utilizing recirculated hydrogen extracted from exhaust fluid, the exhaust fluid resulting from the combustion of hydrocarbon fuel in a combustion chamber, the method comprising the steps of:

a) providing a mixed conductor having a retentate side and a permeate side, the permeate side being exposed to the combustion chamber, the mixed conductor being configured to conduct oxygen ions from the retentate side to the permeate side when the partial pressure of oxygen on the permeate side is lower than the partial pressure of oxygen on the retentate side;
b) providing air to the retentate side;
c) providing pressurized water to the combustion chamber;
d) combusting the hydrocarbon fuel upon a partial pressure of oxygen in the air on the permeate side being lower than the partial pressure of oxygen on the retentate side for providing an oxygen-pure fraction of the air to the combustion chamber, the combustion of the hydrocarbon fuel with the pressurized water and the oxygen-pure fraction of the air forming exhaust fluid;
e) rotating the turbine rotor upon expansion of the exhaust fluid received from the combustion chamber through the exhaust turbine;
f) extracting hydrogen from the expanded exhaust fluid received from the exhaust turbine;
g) pressurizing the extracted hydrogen; and
h) recirculating the pressurized extracted hydrogen through the exhaust turbine.

16. The method of Claim 15 wherein the exhaust fluid contains water and carbon dioxide and step (f) includes:
a) absorbing the carbon dioxide into the water; and
b) venting a portion of the carbon dioxide to atmosphere.

17. The method of Claim 15 wherein the exhaust fluid contains steam and step (g) includes:

a) generating heat by condensing steam in the exhaust fluid; and

b) pressurizing the hydrogen in the exhaust fluid to a pressure greater than the pressure on the permeate side of the combustion chamber by using heat of condensation of the steam.

18. The method of Claim 15 wherein step (h) includes heating the hydrogen by recirculation of the hydrogen along the retentate side during combustion of the hydrocarbon fuel.